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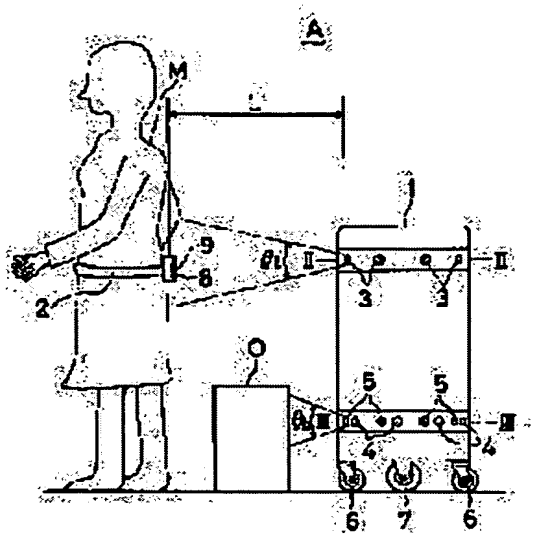
(54) USER TRACKING TYPE MOVING ROBOT DEVICE AND SENSING METHOD

(57)Abstract:
PURPOSE: To provide a user tracking type moving robot device and sensing method which can perform sensing for user tracking and the sensing for obstacle evasion by single sensing technology.
CONSTITUTION: Light receiving sensors 3 for tracking and pairs of infrared-light emitting elements 4 for detection and light receiving sensors 5 for detection are separated at necessary height of a moving robot 1, and the detection visual field areas t and b of the light receiving sensors 3 for detection and light receiving sensors 5 for detection are set spatially at a vertical distance without overlapping and interfering with each other.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] In the user tailing mold mobile-robot equipment which follows the user back and moves while recognizing the location of a user and an obstruction and avoiding the obstruction concerned The source for tailing of infrared radiation with which a user's body is equipped and which floodlights the infrared radiation for tailing, The light-receiving sensor for tailing which is prepared for said mobile robot, receives the infrared radiation for tailing floodlighted from the source for tailing concerned of infrared radiation, and outputs a confirmation signal, The infrared light emitting device for detection which is prepared for said mobile robot and floodlights the infrared radiation for detection around the mobile robot concerned, Said mobile robot opposite-** with the infrared light emitting device for detection concerned, and the reflected light of the infrared radiation for detection floodlighted in the infrared light emitting device for detection concerned is received. The control system equipped with a means to recognize a user's location based on the confirmation signal of the light-receiving sensor for detection which outputs a searching signal, and said light-receiving sensor for tailing, and a means to recognize the location of an obstruction based on the searching signal of said light-receiving sensor for detection, User tailing mold mobile-robot equipment characterized by having ****(ed), having changed necessary height in the mobile robot and having arranged the pair of said light-receiving sensor for tailing, and a said infrared light emitting device for detection and said light-receiving sensor for detection to him.
[Claim 2] Said source for tailing of infrared radiation is user tailing mold mobile-robot equipment according to claim 1 characterized by equipping the belt fastened on a user's waist.
[Claim 3] Said source for tailing of infrared radiation is user tailing mold mobile-robot equipment according to claim 1 characterized by equipping the hat which a user is wearing.
[Claim 4] Said light-receiving sensor for tailing is user tailing mold mobile-robot equipment according to claim 1, 2, or 3 which is formed and is characterized by being arranged at intervals of predetermined in a mobile robot's peripheral face hoop direction. [two or more]
[Claim 5] User tailing mold mobile-robot equipment according to claim 1, 2, 3, or 4 characterized by having a means to adjust the installation height to the mobile robot of said light-receiving sensor for tailing, and said light-receiving sensor for detection to arbitration.
[Claim 6] Said infrared light emitting device for detection and said light-receiving sensor for detection are user tailing mold mobile-robot equipment according to claim 1, 2, 3, 4, or 5 which makes it a pair, is formed and is characterized by being arranged at intervals of predetermined in a mobile robot's peripheral face hoop direction. [two or more]
[Claim 7] Said control system is user tailing mold mobile-robot equipment according to claim 1, 2, 3, 4, 5, or 6 which carries out time-sharing processing of confirmation and the searching signal of said light-receiving sensor for tailing, and said light-receiving sensor for detection in one digital disposal circuit, and is characterized by having a means to recognize a user's location and the location of an obstruction.
[Claim 8] Said mobile robot is user tailing mold mobile-robot equipment according to claim 1, 2, 3, 4, 5, 6, or 7 characterized by having the stowage for storages which functions as the vehicle for medical implement conveyance in a hospital, the picking vehicle of the load in a warehouse,

the cart for suitcase conveyance in an airport, or a cart for shopping in shopping.
[Claim 9] Said mobile robot is user tailing mold mobile-robot equipment according to claim 1, 2, 3, 4, 5, 6, 7, or 8 characterized by having **** which is controlled free and drives the migration direction in said control system.
[Claim 10] In sensing of the user tailing mold mobile-robot equipment which follows the user back while recognizing the location of a user and an obstruction and avoiding the obstruction concerned The light-receiving sensor for tailing which received the infrared radiation for tailing with which a user's body was equipped, and which is floodlighted from the source for tailing of infrared radiation, and was prepared for said mobile robot, The light-receiving sensor for detection which received the reflected light of the infrared radiation for detection floodlighted around the mobile robot concerned from the infrared light emitting device for detection prepared for the mobile robot concerned, and was prepared for the mobile robot concerned with the infrared light emitting device for detection concerned, The sensing approach of the user tailing mold mobile-robot equipment characterized by performing sensing so that the location of a user and an obstruction may be recognized as a ********** light-receiving visual field does not carry out duplication interference mutually.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the sensing approach of the user tailing mold mobile-robot equipment which follows the user back who moves, avoiding an obstruction and conveys a load etc., and this equipment.
[0002]
[Description of the Prior Art] As conventional user tailing mold mobile-robot equipment, the signal from the user who ****(ed) the ultrasonic transmitter is detected, for example, and there is an ultrasonic induction type automatic guided vehicle "ROPOTA" which opens a fixed distance and follows it (the robotics handbooks P703-P704, 1990 issue edited by Robotics Society of Japan). With this kind of mobile-robot equipment, the ultrasonic transmitter and the ultrasonic sensor were used for sensing for recognizing the location of the user who moves, photosensor was used for sensing for avoiding the obstruction on a floor line further, the mutual intervention was prevented through a medium of a heterogeneous projection sensing signal, and coexistence of control of the robot action which suits tailing and evasion and is contradictory is aimed at.
[0003]
[Problem(s) to be Solved by the Invention] By the way, since photosensor was used for sensing of an obstruction while using the ultrasonic sensor for sensing which follows a user according to the user tailing mold mobile-robot equipment of the conventional example, as described above, a digital disposal circuit which is different in a mobile robot's behavior control was needed. Therefore, there is a problem of existence of a different digital disposal circuit serving as a bottleneck in the miniaturization of mobile-robot equipment, making the circuit design of mobile-robot equipment complicating further, worsening productive efficiency as a result, and making a manufacturing cost comparatively high-priced.
[0004] The main purposes which should solve this invention in here are as follows. The 1st purpose of this invention uses the user tailing mold mobile-robot equipment and the sensing approach of performing sensing of user tailing, and sensing of obstacle avoidance in a single sensing technology as an offer plug.
[0005] The 2nd purpose of this invention uses the user tailing mold mobile-robot equipment and the sensing approach of avoiding sensing of user tailing, and the duplication interference between sensing of obstacle avoidance as an offer plug.
[0006] The 3rd purpose of this invention uses the user tailing mold mobile-robot equipment and the sensing approach of attaining miniaturization of equipment, simplification of a circuit design, improvement in productive efficiency, and reduction-ization of a manufacturing cost as an offer plug.
[0007] The purpose of others of this invention will become naturally clear from the publication of a specification, a drawing, especially a claim.
[0008]
[Means for Solving the Problem] Solution of said technical problem attains said purpose, when this invention adopts the new characteristic configuration means and the technique of next

enumerating. Namely, the 1st description of this invention equipment is set to the user tailing mold mobile-robot equipment which follows the user back and moves, recognizing the location of a user and an obstruction and avoiding the obstruction concerned. The source for tailing of infrared radiation with which a user's body is equipped and which floodlights the infrared radiation for tailing, The light-receiving sensor for tailing which is prepared for said mobile robot, receives the infrared radiation for tailing floodlighted from the source for tailing concerned of infrared radiation, and outputs a confirmation signal, The infrared light emitting device for detection which is prepared for said mobile robot and floodlights the infrared radiation for detection around the mobile robot concerned, Said mobile robot opposite-** with the infrared light emitting device for detection concerned, and the reflected light of the infrared radiation for detection floodlighted in the infrared light emitting device for detection concerned is received. The control system equipped with a means to recognize a user's location based on the confirmation signal of the light-receiving sensor for detection which outputs a searching signal, and said light-receiving sensor for tailing, and a means to recognize the location of an obstruction based on the searching signal of said light-receiving sensor for detection, It **** and is in the user tailing mold mobile-robot equipment which changes necessary height and comes to arrange the pair of said light-receiving sensor for tailing, and a said infrared light emitting device for detection and said light-receiving sensor for detection to a mobile robot.

[0009] The 2nd description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to equip said source for tailing of infrared radiation in the 1st description of said this invention equipment the belt fastened on a user's waist.

[0010] The 3rd description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to equip said source for tailing of infrared radiation in the 1st description of said this invention equipment the hat which a user is wearing.

[0011] The 4th description of this invention equipment forms two or more said light-receiving sensors for tailing in the 1st, 2nd, or 3rd description of said this invention equipment, and is in the user tailing mold mobile-robot equipment which it comes to arrange to a mobile robot's peripheral face hoop direction at intervals of predetermined.

[0012] The 5th description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to have a means to adjust the installation height to the mobile robot of said light-receiving sensor for tailing in the 1st, 2nd, 3rd, or 4th description of said this invention equipment, and said light-receiving sensor for detection to arbitration.

[0013] The 6th description of this invention equipment makes a pair said infrared light emitting device for detection in the 1st, 2nd, 3rd, 4th, or 5th description of said this invention equipment, and said light-receiving sensor for detection, forms them, and is in the user tailing mold mobile-robot equipment which it comes to arrange at predetermined spacing in a mobile robot's peripheral face hoop direction. [two or more]

[0014] Said control system in the 1st, 2nd, 3rd, 4th, 5th, or 6th description of said this invention equipment carries out time-sharing processing of confirmation and the searching signal of said light-receiving sensor for tailing, and said light-receiving sensor for detection in one digital disposal circuit, and the 7th description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to have a means to recognize a user's location and the location of an obstruction.
 [0015] The 8th description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to have the stowage for storages where said mobile robot in the 1st, 2nd, 3rd, 4th, 5th, 6th, or 7th description of said this invention equipment functions as the vehicle for medical implement conveyance in a hospital, the picking vehicle of the load in a warehouse, the cart for suitcase conveyance in an airport, or a cart for shopping in shopping.

[0016] The 9th description of this invention equipment is in the user tailing mold mobile-robot equipment which comes to have **** to which said mobile robot in the 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, or 8th description of said this invention equipment is controlled free, and drives the migration direction in said control system.

[0017] The description of this invention approach, recognizing the location of a user and an obstruction and avoiding the obstruction concerned The light-receiving sensor for tailing which

received the infrared radiation for tailing with which a user's body was equipped, and which is floodlighted from the source for tailing of infrared radiation in sensing of the user tailing mold mobile-robot equipment which follows the user back, and was prepared for said mobile robot, The light-receiving sensor for detection which received the reflected light of the infrared radiation for detection floodlighted around the mobile robot concerned, and was prepared for the mobile robot concerned with the infrared light emitting device for detection concerned from the infrared light emitting device for detection prepared for the mobile robot concerned, As a ********** light-receiving visual field does not carry out duplication interference mutually, it is in the sensing approach of the user tailing mold mobile-robot equipment which performs sensing and becomes so that the location of a user and an obstruction may be recognized.

[0018]

[Function] Since this invention has devised above means and technique, it acts the following. That is, even if it uses a homogeneous infrared signal for sensing of user tailing, and sensing of obstacle avoidance, the mutual intervention of a sensing signal does not happen, but there is no malfunction, and insurance can be made to drive in the 1st description of this invention equipment, since necessary height was changed in the mobile robot and the light-receiving sensor for tailing and the light-receiving sensor for detection are arranged to him.

[0019] Since a belt is equipped with the source for tailing of infrared radiation in the 2nd description of this invention equipment and the hat is equipped with it in the 3rd description of this invention equipment again, respectively, a user can attach the source for tailing indispensable to sensing of infrared radiation in a user's proper place only by the action which fastens a belt on the waist or is wearing a hat on the head.

[0020] In the 4th description of this invention equipment, since a mobile robot's peripheral face hoop direction is made to arrange two or more light-receiving sensors for tailing at intervals of necessary, the horizontal light-receiving range of the infrared radiation for tailing with which the user was equipped and which is floodlighted from the source for tailing of infrared radiation covers an omnidirection, and it becomes large, and a mobile robot can follow correctly, without missing the user back.

[0021] In the 5th description of this invention equipment, since it has a means to adjust the installation height to the mobile robot of the light-receiving sensor for tailing, and the light-receiving sensor for detection to arbitration, it can be made to be able to respond to the height of the obstruction of a site, and versatility can be raised. Here, the policy which enables contraction of the mobile robot itself which attached the photo sensor in the height direction as a means to adjust the installation height to the mobile robot of each photo sensor to arbitration, the policy which enables contraction of a rod with a photo sensor in the height direction, and attaches it in a mobile robot, the policy which attaches a photo sensor using a unit with easy migration of an installation part can be mentioned.

[0022] In the 6th description of this invention equipment, since the infrared light emitting device for detection and the light-receiving sensor for detection were made into the pair and arranged at intervals of necessary to a mobile robot's peripheral face hoop direction, the horizontal range which supervises an obstruction covers an omnidirection, and becomes large, and a mobile robot's insurance transit of it is attained more.

[0023] In the 7th description of this invention equipment, since a control system processes each infrared signal of the light-receiving sensor for tailing, and the light-receiving sensor for detection in one digital disposal circuit, the miniaturization of equipment and the simplification of a circuit design of it are attained more.

[0024]

[Example] Hereafter, with reference to an accompanying drawing, this invention is explained more to a detail based on the example of equipment, and the example of the sensing approach.

[0025] (Example 1 of equipment) Drawing 1 shows the configuration of the user tailing mold mobile-robot equipment A concerning this example of equipment. User tailing mold mobile-robot equipment A consists of a mobile robot 1 and a belt 2 for users, as shown in drawing 1 .

[0026] The case is a cylindrical shape and the mobile robot 1 has the light-receiving sensor 3 for tailing, the infrared light emitting device 4 for detection, the light-receiving sensor 5 for

detection, and **** 6 and 7. In addition, in this example of equipment, although a mobile robot's 1 case was used as the cylindrical shape, the case of the mobile robot of this invention equipment may not be limited to this configuration, and you may make it box forms, such as a rectangular parallelepiped.
[0027] It is arranged at equal intervals that it seems that the light-receiving sensor 3 for tailing consists of infrared light-receiving sensors for user tailing, continues throughout the peripheral face hoop direction of the mobile robot 1 corresponding to the height of User's M waist, and is shown in necessary spacing at six and drawing 2 . Drawing 2 shows the expanded sectional view in alignment with cutting-plane-line I-I in drawing 1 here.
[0028] It is arranged at equal intervals that it seems that the sensing equipment for obstruction detection consists of pairs, and the infrared light emitting device 4 for detection and the light-receiving sensor 5 for detection continue throughout the peripheral face hoop direction of the mobile robot 1 corresponding to the height under User's M knee, and are shown in necessary spacing at 6 sets and drawing 3 . Drawing 3 shows the expanded sectional view in alignment with cutting-plane-line II-II in drawing 1 here.
[0029] In order to prevent interference with the infrared radiation for tailing which the light-receiving sensor 3 for tailing receives, and the infrared radiation for detection which the light-receiving sensor 5 for detection receives in this example of equipment While making necessary spacing separation carry out in a mobile robot's 1 height direction and arranging the pair of the light-receiving sensor 3 for tailing, and the infrared light emitting device 4 for detection and the light-receiving sensor 5 for detection detection visual field field thetat of the light-receiving sensor 3 for tailing, and the light-receiving sensor 5 for detection, and thetab it does not overlap -- as -- spatial -- respectively -- the upper and lower sides -- alienation -- it set up.
[0030] **** 6 and 7 is formed in four inferior surfaces of tongue of a mobile robot's 1 case, among those two of order are [two, axle-pin-rake **** 6 and the direction of a side,] drive **** 7 towards User M. Drive **** 7 is controlled by the backward acting signal of the control system of the mobile robot 1 which omitted drawing free in the migration direction, and constitutes a mobile robot's 1 drive.
[0031] The digital disposal circuit (drawing is omitted) which carries out time-sharing processing of each infrared signal of the light-receiving sensor 3 for tailing and the light-receiving sensor 5 for detection is prepared in a mobile robot's 1 control system from the standpoint of the miniaturization of equipment, and the simplification of a circuit design. In addition, although it was made the configuration which prepares one digital disposal circuit in this example of equipment, the rate of signal processing may be raised or a digital disposal circuit may be made the configuration to prepare [two or more] from the standpoint of prevention of malfunction.
[0032] The location which hits the belt 2 for users at the tooth-back side of User's M waist is equipped with the source unit 8 for tailing of infrared radiation, and the source 9 for tailing of infrared luminescence which floodlights the infrared radiation for tailing towards a mobile robot's 1 light-receiving sensor 3 for tailing is established in this source unit 8 for tailing of infrared radiation.
[0033] (Example 1 of an approach) Next, the example of an approach of the sensing approach of this invention using the user tailing mold mobile-robot equipment A of the example 1 of equipment mentioned above is explained. In using this equipment A, first, User M turns ON each power source of the source unit 8 for tailing of the belt 2 for users of infrared radiation, and a mobile robot 1, and **** the belt 2 for users on the waist.
[0034] If User M does walk migration after these sets are completed, tailing of the user M whom the light-receiving sensor 3 for tailing receives the infrared radiation for tailing floodlighted from the source 9 for tailing of the source unit 8 for tailing of infrared radiation of infrared luminescence, and a mobile robot 1 moves will be started. In order to perform sensing which recognizes User's M location at this time, by a mobile robot's 1 control system, a driving signal is sent out to the driving source of drive **** 7 so that the confirmation signal outputted from the light-receiving sensor 3 for tailing may be processed in a digital disposal circuit and the distance L of the User M and the mobile robot 1 which move may be maintained.
[0035] In order to perform sensing which recognizes the location of Obstruction O, floodlighting

the infrared radiation for detection by the infrared light emitting device 4 for detection, in case the user M who moves is followed is continued around a mobile robot. And if Obstruction O exists in a mobile robot's 1 transit path, the infrared radiation for detection reflected with the obstruction O will be received by the light-receiving sensor 5 for detection. At this time, by a mobile robot's 1 control system, the searching signal outputted from the light-receiving sensor 5 for detection is processed in a digital disposal circuit, the location of Obstruction O is recognized, and a driving signal is sent out to the driving source of drive **** 7 so that that obstruction O may be avoided.

[0036] As explained above, if the sensing approach of the user tailing mold mobile-robot equipment of this example of an approach is adopted in a user's tailing and evasion of an obstruction, sensing can be performed only with the single technique using an infrared sensor, and improvement in the miniaturization of equipment, the simplification of a circuit design, and the productive efficiency of equipment and reduction-ization of a manufacturing cost can be attained.

[0037] (Example 2 of equipment) Drawing 4 shows the configuration of the user tailing mold mobile-robot equipment B concerning this example of equipment. In addition, the same sign was used for the part which functions as the above mentioned example 1 of equipment similarly. That this example of equipment differs from the example 1 of equipment is the point that the installation height of the light-receiving sensor 3 for tailing in the point and mobile robot 1 which use the hat 10 which equipped with the source unit 8 for tailing of infrared radiation instead of, the infrared light emitting device 4 for detection, and the light-receiving sensor 5 for detection is higher than the example 1 of equipment. [the belt 2 for users]

[0038] The light-receiving sensor 3 for tailing is arranged by six peripheral face regular intervals of a ring formation 11, and ring formation 11 the very thing is projected from the center of a mobile robot's 1 head, and is attached in the height direction at the tip of the rod 12 which carries out contraction adjustment. The sensing equipment for obstruction detection consists of pairs, and the infrared light emitting device 4 for detection and 6 sets of light-receiving sensors 5 for detection are arranged at equal intervals in the peripheral face hoop direction of the mobile robot 1 corresponding to the height on User's M knee. and the example 1 of equipment -- the same -- detection visual field field thetat of the light-receiving sensor 3 for tailing, and the light-receiving sensor 5 for detection, and thetab duplication interference is not carried out mutually -- as -- height -- changing -- spatial -- respectively -- alienation -- it is set up.

[0039] According to this example of equipment, since the infrared light emitting device 4 for detection and the light-receiving sensor 5 for detection are arranged in a location higher than the case of the example 1 of equipment, in the example 1 of equipment, it becomes detectable [the tall obstruction which is hard to be detected]. Moreover, user tailing mold mobile-robot equipment with the versatility which was adapted for various sites can be offered.

[0040] In addition, although the configuration which shrinks the rod 12 with the light-receiving sensor 3 for tailing in the height direction was adopted in this example of equipment in order to adjust the installation height to the mobile robot 1 of the light-receiving sensor 3 for tailing to arbitration It is good even if adjustment of installation height, such as a photo sensor, is possible using the unit with easy migration of an installation location in enabling contraction for example, of not the thing that limits this invention to this but mobile-robot 1 the very thing in the height direction.

[0041] It can consider preparing the suitable stowage for storages as an application of the user tailing mold mobile-robot equipment explained above, and making it function as the vehicle for medical implement conveyance in a hospital, the picking vehicle of the load in a warehouse, the cart for suitcase conveyance in an airport, or a cart for shopping in shopping.

[0042]

[Effect of the Invention] Since according to the ****** sensing approach of this invention necessary spacing separation was made to carry out in a mobile robot's height direction and the light-receiving sensor for tailing and the light-receiving sensor for detection are arranged as explained above, the effectiveness that sensing of user tailing and sensing of obstacle avoidance can be performed in a single sensing technology is done so. Especially, in this invention, since

the common processing of a user's tailing and the sensing signal of obstacle avoidance can be carried out in the same digital disposal circuit, improvement in the miniaturization of equipment, the simplification of a circuit design, and the productive efficiency of equipment and reduction-ization of a manufacturing cost can be attained.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the side elevation having shown the configuration of the user tailing mold mobile-robot equipment A in the example 1 of equipment of this invention.
[Drawing 2] It is an expanded sectional view in alignment with cutting-plane-line I-I in drawing 1 .

[Drawing 3] It is an expanded sectional view in alignment with cutting-plane-line II-II in drawing 1 .
[Drawing 4] It is the side elevation having shown the configuration of the user tailing mold mobile-robot equipment B in the example 2 of equipment of this invention.
[Description of Notations]
A, B -- User tailing mold mobile-robot equipment
1 -- Mobile robot
2 -- Belt for users
3 -- Light-receiving sensor for tailing
4 -- Infrared light emitting device for detection
5 -- Light-receiving sensor for detection
6 -- Axle-pin-rake ****
7 -- Drive ****
8 -- Source unit for tailing of infrared radiation
9 -- Source for tailing of infrared luminescence
10 -- Hat
11 -- Ring formation
12 -- Rod

[Translation done.]

(書誌＋要約＋請求の範囲)

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(57)【要約】
【目的】ユーザ追尾のセンシング及び障害物回避のセンシングを単一のセンシング技術にて実行できるユーザ追尾型移動ロボット装置及びセンシング方法を提供する。
【構成】追尾用受光センサ3と、探知用赤外線発光素子4及び探知用受光センサ5の対と、を移動ロボット1の所要高さを違えて分離して、追尾用受光センサ3と探知用受光センサ5との検出視野領域 t と b とを相互重複干渉しないように空間的に上下離間設定したことを特徴とする。

【特許請求の範囲】
【請求項1】ユーザ及び障害物の位置を認識して当該障害物を回避しながら、ユーザの後を追尾して移動するユーザ追尾型移動ロボット装置において、ユーザの体に装着され、追尾用赤外線を投光する追尾用赤外線源と、前記移動ロボットに設けられ、当該追尾用赤外線源から投光された追尾用赤外線を受光して追認信号を出力する追尾用受光センサと、前記移動ロボットに設けられ、当該移動ロボット周辺に探知用赤外線を投光する探知用赤外線発光素子と、前記移動ロボットに当該探知用赤外線発光素子と共に対設され、当該探知用赤外線発光素子にて投光された探知用赤外線の反射光を受光して、探出信号を出力する探知用受光センサと、前記追尾用受光セ

ンサの追認信号に基づいてユーザの位置を認識する手段、及び前記探知用受光センサの探出信号に基づいて障害物の位置を認識する手段を備えた制御系と、を有し、前記追尾用受光センサと、前記探知用赤外線発光素子及び前記探知用受光センサの対と、を移動ロボットに所要高さを違えて配置したことを特徴とするユーザ追尾型移動ロボット装置。
【請求項2】前記追尾用赤外線源は、ユーザの腰に締めるベルトに装着したことを特徴とする、請求項1に記載のユーザ追尾型移動ロボット装置。
【請求項3】前記追尾用赤外線源は、ユーザが被る帽子に装着したことを特徴とする、請求項1に記載のユーザ追尾型移動ロボット装置。
【請求項4】前記追尾用受光センサは、複数設けられ、移動ロボットの外周面周方向に所定間隔で配列されたことを特徴とする、請求項1、2又は3に記載のユーザ追尾型移動ロボット装置。
【請求項5】前記追尾用受光センサ及び前記探知用受光センサの移動ロボットへの取り付け高さを任意に調整する手段を備えたことを特徴とする、請求項1、2、3又は4に記載のユーザ追尾型移動ロボット装置。
【請求項6】前記探知用赤外線発光素子及び前記探知用受光センサは、一対にして複数設けられ、移動ロボットの外周面周方向に所定間隔で配列されたことを特徴とする、請求項1、2、3、4又は5に記載のユーザ追尾型移動ロボット装置。
【請求項7】前記制御系は、前記追尾用受光センサ及び前記探知用受光センサの追認及び探出信号を一つの信号処理回路にて時分割処理し、ユーザの位置及び障害物の位置を認識する手段を備えたことを特徴とする、請求項1、2、3、4、5又は6に記載のユーザ追尾型移動ロボット装置。
【請求項8】前記移動ロボットは、病院における医療具運搬用の車、倉庫における荷物のピッキング車、空港におけるスーツケース搬送用のカート、又はショッピングにおける買い物用のカートとして機能する物入れ用収納部を備えたことを特徴とする、請求項1、2、3、4、5、6又は7に記載のユーザ追尾型移動ロボット装置。
【請求項9】前記移動ロボットは、前記制御系にて移動方向を自在に制御されて駆動する脚輪を備えたことを特徴とする、請求項1、2、3、4、5、6、7又は8に記載のユーザ追尾型移動ロボット装置。
【請求項10】ユーザ及び障害物の位置を認識して当該障害物を回避しながら、ユーザの後を追尾するユーザ追尾型移動ロボット装置のセンシングに当たり、ユーザの体に装着された追尾用赤外線源から投光する追尾用赤外線を受光し、かつ前記移動ロボットに設けられた追尾用受光センサと、当該移動ロボットに設けられた探知用赤外線発光素子から当該移動ロボット周辺に投光する探知用赤外線の反射光を受光し、かつ当該移動ロボットに当該探知用赤外線発光素子と共に設けられた探知用受光センサと、のそれぞれ受光視野が相互に重複干渉しないようにして、ユーザと障害物の位置を認識するようにセンシングを実行することを特徴とするユーザ追尾型移動ロボット装置のセンシング方法。

詳細な説明

【発明の詳細な説明】
【0001】
【産業上の利用分野】本発明は、移動するユーザの後を、障害物を回避しながら追尾して荷物等の搬送を行うユーザ追尾型移動ロボット装置、及び同装置のセンシング方法に関する。
【0002】
【従来の技術】従来のユーザ追尾型移動ロボット装置としては、例えば、超音波発信器を着帯したユーザからのシグナルを検知し、一定の距離を開けて追従する超音波誘導式無人搬送車「ロボータ」がある(ロボット工学ハンドブックP703～P704、日本ロボット学会編1990年発行)。この種の移動ロボット装置では、移動するユーザの位置を認識するためのセンシングに超音波発信器及び超音波センサを用い、さらに床面上の障害物を回避するためのセンシングにフォトセンサを用いて、異質な投射センシング信号の媒介により相互干渉を防止し、追尾と回避のあい矛盾するロボット行動の制御の両立をはかっている。
【0003】
【発明が解決しようとする課題】ところで、従来例のユーザ追尾型移動ロボット装置によれば、前記したようにユーザを追尾するセンシングに超音波センサを用いるとともに、障害物のセンシングにフォトセンサを用いているので、移動ロボットの行動制御に異なる信号処理回路を必要としていた。したがって、異なる信号処理回路の存在が移動ロボット装置の小型化においてボトルネックとなり、さらに移動ロボット装置の回路設計を複雑化させ、結果的に生産効率を悪くさせ、製造コストを割高にさせているという問題がある。
【0004】ここにおいて本発明の解決すべき主要な目的は、次の通りである。本発明の第1の目的は、ユーザ追尾のセンシング及び障害物回避のセンシングを単一のセンシング技術にて実行できるユーザ追尾型移動ロボット装置及びセンシング方法を提供せんとするものである。
【0005】本発明の第2の目的は、ユーザ追尾のセンシング及び障害物回避のセンシング相互の重複干渉を回避するユーザ追尾型移動ロボット装置及びセンシング方法を提供せんとするものである。
【0006】本発明の第3の目的は、装置の小型化、回路設計の簡素化、生産効率の向上及び製造コストの低減化を図ることができるユーザ追尾型移動ロボット装置及びセンシング方法を提供せんとするものである。
【0007】本発明のその他の目的は、明細書、図面、特に特許請求の範囲の記載から自ずと明らかとなろう。
【0008】
【課題を解決するための手段】前記課題の解決は、本発明が次に列挙する新規な特徴的構成手段及び手法を採用することにより前記目的を達成する。すなわち、本発明装置の第1の特徴は、ユーザ及び障害物の位置を認識して当該障害物を回避しながら、ユーザの後を追尾して移動するユーザ追尾型移動ロボット装置において、ユーザの体に装着され、追尾用赤外線を投光する追尾用赤外線源と、前記移動ロボットに設けられ、当該追尾用赤外線源から投光された追尾用赤外線を受光して追認信号を出力する追尾用受光センサと、前記移動ロボットに設けられ、当該移動ロボット周辺に探知用赤外線を投光する探知用赤外線発光素子と、前記移動ロボットに当該探知用赤外線発光素子と共に対設され、当該探知用赤外線発光素子にて投光された探知用赤外線の反射光を受光して、探出信号を出力する探知用受光センサと、前記追尾用受光センサの追認信号に基づいてユーザの位置を認識する手段、及び前記探知用受光センサの探出信号に基づいて障害物の位置を認識する手段を備えた制御系と、を有し、前記追尾用受光センサと、前記探知用赤外線発光素子及び前記探知用受光センサの対と、を移動ロボットに所要高さを違えて配置してなるユーザ追尾型移動ロボット装置にある。
【0009】本発明装置の第2の特徴は、前記本発明装置の第1の特徴における前記追尾用赤外線源を、ユーザの腰に締めるベルトに装着してなるユーザ追尾型移動ロボット装置にある。
【0010】本発明装置の第3の特徴は、前記本発明装置の第1の特徴における前記追尾用赤外線源を、ユーザが被る帽子に装着してなるユーザ追尾型移動ロボット装置にある。
【0011】本発明装置の第4の特徴は、前記本発明装置の第1、第2又は第3の特徴における前記追尾用受光センサを複数設け、移動ロボットの外周面周方向に所定間隔で配列してなるユーザ追尾型移動ロボット装置にある。
【0012】本発明装置の第5の特徴は、前記本発明装置の第1、第2、第3又は第4の特徴におけ

る前記追尾用受光センサ及び前記探知用受光センサの移動ロボットへの取り付け高さを任意に調整する手段を備えてなるユーザ追尾型移動ロボット装置にある。
【0013】本発明装置の第6の特徴は、前記本発明装置の第1、第2、第3、第4又は第5の特徴における前記探知用赤外線発光素子及び前記探知用受光センサを、一対にして複数設け、移動ロボットの外周面周方向に所定間隔に配列してなるユーザ追尾型移動ロボット装置にある。
【0014】本発明装置の第7の特徴は、前記本発明装置の第1、第2、第3、第4、第5又は第6の特徴における前記制御系が、前記追尾用受光センサ及び前記探知用受光センサの追認及び探出信号を一つの信号処理回路にて時分割処理し、ユーザの位置及び障害物の位置を認識する手段を備えてなるユーザ追尾型移動ロボット装置にある。
【0015】本発明装置の第8の特徴は、前記本発明装置の第1、第2、第3、第4、第5、第6又は第7の特徴における前記移動ロボットが、病院における医療具運搬用の車、倉庫における荷物のピッキング車、空港におけるスーツケース搬送用のカート、又はショッピングにおける買い物用のカートとして機能する物入れ用収納部を備えてなるユーザ追尾型移動ロボット装置にある。
【0016】本発明装置の第9の特徴は、前記本発明装置の第1、第2、第3、第4、第5、第6、第7又は第8の特徴における前記移動ロボットが、前記制御系にて移動方向を自在に制御されて駆動する脚輪を備えてなるユーザ追尾型移動ロボット装置にある。
【0017】本発明方法の特徴は、ユーザ及び障害物の位置を認識して当該障害物を回避しながら、ユーザの後を追尾するユーザ追尾型移動ロボット装置のセンシングに当たり、ユーザの体に装着された追尾用赤外線源から投光する追尾用赤外線を受光し、かつ前記移動ロボットに設けられた追尾用受光センサと、当該移動ロボットに設けられた探知用赤外線発光素子から、当該移動ロボット周辺に投光する探知用赤外線の反射光を受光し、かつ当該移動ロボットに当該探知用赤外線発光素子と共に設けられた探知用受光センサと、のそれぞれ受光視野が相互に重複干渉しないようにして、ユーザと障害物の位置を認識するようにセンシングを実行してなるユーザ追尾型移動ロボット装置のセンシング方法にある。
【0018】
【作用】本発明は、前記のような手段及び手法を講じているので、以下の作用をなす。すなわち、本発明装置の第1の特徴では、追尾用受光センサと探知用受光センサとを移動ロボットに所要高さを違えて配置しているので、ユーザ追尾のセンシング及び障害物回避のセンシングに同質の赤外線信号を用いても、センシング信号の相互干渉が起こらず、誤動作がなく、安全に駆動させることができる。
【0019】本発明装置の第2の特徴ではベルトに、また、本発明装置の第3の特徴では帽子に、それぞれ追尾用赤外線源が装着されているので、ユーザが腰にベルトを締めたり帽子を頭に被ったりする行為だけで、センシングに必要不可欠の追尾用赤外線源をユーザの適所に取り付けることができる。
【0020】本発明装置の第4の特徴では、複数の追尾用受光センサを移動ロボットの外周面周方向に所要間隔にて配列させているので、ユーザに装着された追尾用赤外線源から投光される追尾用赤外線の水平方向の受光範囲が全方位に亙り広くなり、移動ロボットはユーザの後を見失うことなく正確に追尾することができる。
【0021】本発明装置の第5の特徴では、追尾用受光センサ及び探知用受光センサの移動ロボットへの取り付け高さを任意に調整する手段を備えているので、現場の障害物の高さに対応させることができ、汎用性を高めることができる。ここで、各受光センサの移動ロボットへの取り付け高さを任意に調整する手段としては、受光センサを取り付けた移動ロボット自体を高さ方向に収縮可能にする方策、受光センサ付きの棒を高さ方向に収縮可能にして移動ロボットに取り付ける方策、設置箇所の移動が容易なユニットを使用して受光センサを取り付ける方策等を挙げることができる。
【0022】本発明装置の第6の特徴では、探知用赤外線発光素子及び探知用受光センサを、一対にして移動ロボットの外周面周方向に所要間隔で配列しているので、障害物を監視する水平方向の範囲が全方位に亙り広くなり、より移動ロボットの安全走行が可能となる。
【0023】本発明装置の第7の特徴では、制御系が追尾用受光センサ及び探知用受光センサの各赤外線信号を一つの信号処理回路にて処理するので、より装置の小型化、回路設計の簡素化が可能となる。
【0024】
【実施例】以下、添付図面を参照し、本発明をその装置例及びセンシング方法例に基づいて、より詳細に説明する。

【0025】(装置例1)図1は本装置例に係るユーザ追尾型移動ロボット装置Aの構成を示している。ユーザ追尾型移動ロボット装置Aは、図1に示すように、移動ロボット1と、ユーザ用ベルト2とからなる。
【0026】移動ロボット1は、筐体が円筒形になっており、追尾用受光センサ3、探知用赤外線発光素子4、探知用受光センサ5、脚輪6、7を備えている。なお、本装置例では、移動ロボット1の筐体を円筒形にしたが、本発明装置の移動ロボットの筐体をかかる形状に限定するものではなく、直方体等のボックス形にしても良い。
【0027】追尾用受光センサ3は、ユーザ追尾用赤外線受光センサにて構成され、ユーザMの腰の高さに対応する移動ロボット1の外周面周方向全域に亙り所要間隔に6つ、図2に示すように、等間隔に配列されている。ここで図2は図1中の切断線I－Iに沿った拡大断面図を示している。
【0028】探知用赤外線発光素子4及び探知用受光センサ5は、一対で障害物検知用センシング装置が構成され、ユーザMの膝下の高さに対応する移動ロボット1の外周面周方向全域に亙り所要間隔に6組、図3に示すように、等間隔に配列されている。ここで図3は図1中の切断線II－IIに沿った拡大断面図を示している。
【0029】本装置例では、追尾用受光センサ3が受光する追尾用赤外線と探知用受光センサ5が受光する探知用赤外線との干渉を防止するために、追尾用受光センサ3と、探知用赤外線発光素子4及び探知用受光センサ5の対と、を移動ロボット1の高さ方向に所要間隔分離させて配置するとともに、追尾用受光センサ3と探知用受光センサ5との検出視野領域 t 、 b を重なり合わないよう空間的にそれぞれ上下離間設定した。
【0030】脚輪6、7は、移動ロボット1の筐体の下面に4つ設けられ、そのうちユーザMに向けて前後の2つがキャスタ脚輪6、サイド方向の2つが駆動脚輪7である。駆動脚輪7は、図を省略した移動ロボット1の制御系の出力駆動信号にて移動方向を自在に制御され、移動ロボット1の駆動機構を構成している。
【0031】移動ロボット1の制御系には、装置の小型化、回路設計の簡素化という見地から、追尾用受光センサ3及び探知用受光センサ5の各赤外線信号を時分割処理する信号処理回路(図を省略)が設けられている。なお、本装置例では一つの信号処理回路を設ける構成にしたが、信号処理の速度を高めたり、誤動作の防止の見地から信号処理回路を複数設ける構成にしても良い。
【0032】ユーザ用ベルト2にはユーザMの腰の背面側に当たる位置に追尾用赤外線源ユニット8が装着され、この追尾用赤外線源ユニット8には移動ロボット1の追尾用受光センサ3に向けて追尾用赤外線を投光する追尾用赤外線発光源9が設けられている。
【0033】(方法例1)次に、上述した装置例1のユーザ追尾型移動ロボット装置Aを用いた本発明のセンシング方法の方法例について説明する。ユーザMは、本装置Aを使用するに当たり、先ず、ユーザ用ベルト2の追尾用赤外線源ユニット8、及び移動ロボット1の各電源をオンにし、腰にユーザ用ベルト2を着帯する。
【0034】これらのセットが完了した後に、ユーザMが歩行移動すると、追尾用赤外線源ユニット8の追尾用赤外線発光源9から投光される追尾用赤外線を追尾用受光センサ3が受光して移動ロボット1が移動するユーザMの追尾を開始する。このとき、ユーザMの位置を認識するセンシングを行うため、移動ロボット1の制御系では、追尾用受光センサ3から出力される追認信号を信号処理回路にて処理し、移動するユーザMと移動ロボット1との距離Lを維持するように駆動脚輪7の駆動源に駆動信号を送出する。
【0035】移動するユーザMを追尾する際、探知用赤外線発光素子4では障害物Oの位置を認識するセンシングを行うため、移動ロボット周辺に探知用赤外線を投光し続ける。そして、移動ロボット1の走行経路中に障害物Oが存在すると、その障害物Oにて反射された探知用赤外線が探知用受光センサ5に受光される。このとき、移動ロボット1の制御系では、探知用受光センサ5から出力される探出信号を信号処理回路にて処理し、障害物Oの位置を認識して、その障害物Oを回避するように駆動脚輪7の駆動源に駆動信号を送出する。
【0036】以上説明したように、ユーザの追尾及び障害物の回避において、本方法例のユーザ追尾型移動ロボット装置のセンシング方法を採用すれば、赤外線センサを用いた単一の技術だけでセンシングを実行でき、装置の小型化、回路設計の簡素化、装置の生産効率の向上及び製造コストの低減化を図ることができる。
【0037】(装置例2)図4は本装置例に係るユーザ追尾型移動ロボット装置Bの構成を示している。なお、前記した装置例1と同様に機能する箇所には同じ符号を用いた。本装置例が装置例1と異なるのは、ユーザ用ベルト2の代わりに追尾用赤外線源ユニット8を装着した帽子10を用いて

いる点、移動ロボット1における追尾用受光センサ3、探知用赤外線発光素子4及び探知用受光センサ5の取り付け高さが装置例1よりも高い点である。

【0038】追尾用受光センサ3は、環体11の外周面等間隔に6つ配列されており、環体11自体は、移動ロボット1の頭部の中央から突出して高さ方向に収縮調整する棒12の先端に取り付けられている。探知用赤外線発光素子4及び探知用受光センサ5は、一対で障害物検知用センシング装置が構成され、ユーザMの膝上の高さに対応する移動ロボット1の外周面周方向に等間隔で6組、配列されている。そして、装置例1と同様に、追尾用受光センサ3と探知用受光センサ5との検出視野領域 t 、 b は相互に重複干渉しないように高さを違えて空間的にそれぞれ離間設定されている。

【0039】本装置例によれば、探知用赤外線発光素子4及び探知用受光センサ5が、装置例1の場合よりも高い位置に配置されるので、装置例1では検出されにくい、背が高い障害物の検出が可能となる。また、さまざまな現場に適応した汎用性のあるユーザ追尾型移動ロボット装置を提供することができる。

【0040】なお、本装置例では、追尾用受光センサ3の移動ロボット1への取り付け高さを任意に調整するため、追尾用受光センサ3が付いた棒12を高さ方向に収縮させる構成を採用したが、本発明をこれに限定するものではなく、例えば、移動ロボット1自体を高さ方向に収縮可能にしたり、設置位置の移動が容易なユニットを使用して受光センサ等の取り付け高さを調整可能にしても良い。

【0041】以上説明したユーザ追尾型移動ロボット装置の応用例としては、適当な物入れ用収納部を設けて、病院における医療具運搬用の車、倉庫における荷物のピッキング車、空港におけるスーツケース搬送用のカート、又はショッピングにおける買い物用のカート等として機能させることが考えられる。

【0042】

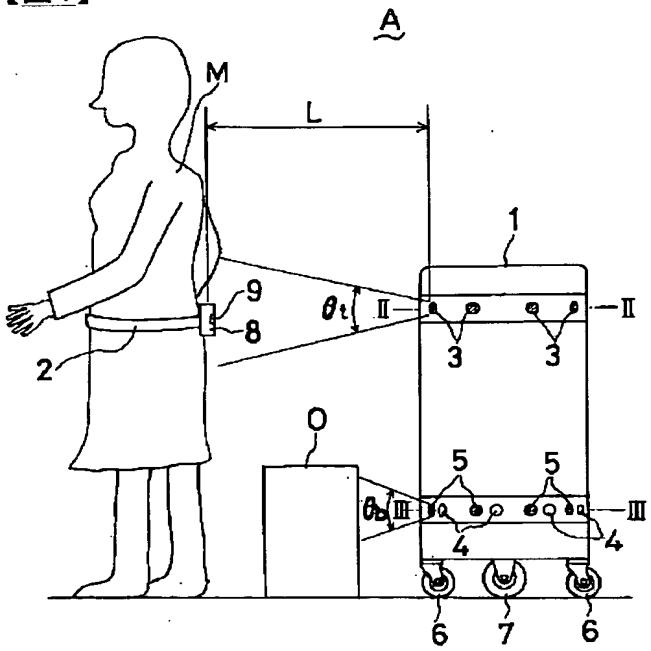
【発明の効果】以上説明したように本発明の装置及センシング方法によれば、追尾用受光センサと探知用受光センサとを移動ロボットの高さ方向に所要間隔分離させて配置しているので、ユーザ追尾のセンシング及び障害物回避のセンシングを単一のセンシング技術にて実行できるという効果を奏する。特に、本発明では、ユーザの追尾及び障害物回避のセンシング信号が同じ信号処理回路にて共用処理できるので、装置の小型化、回路設計の簡素化、装置の生産効率の向上及び製造コストの低減化を図ることができる。

図の説明

【図面の簡単な説明】
【図1】本発明の装置例1におけるユーザ追尾型移動ロボット装置Aの構成を示した側面図である。
【図2】図1中の切断線I－Iに沿った拡大断面図である。
【図3】図1中の切断線II－IIに沿った拡大断面図である。
【図4】本発明の装置例2におけるユーザ追尾型移動ロボット装置Bの構成を示した側面図である。
【符号の説明】
A、B…ユーザ追尾型移動ロボット装置
1…移動ロボット
2…ユーザ用ベルト
3…追尾用受光センサ
4…探知用赤外線発光素子
5…探知用受光センサ
6…キャスタ脚輪
7…駆動脚輪
8…追尾用赤外線源ユニット
9…追尾用赤外線発光源
10…帽子
11…環体
12…棒

図面

【図1】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L
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8
2
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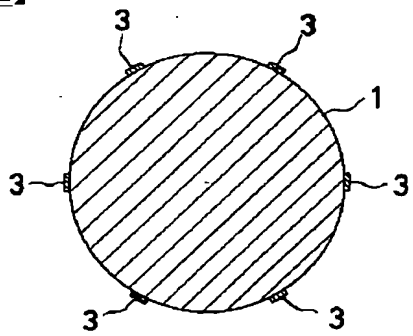
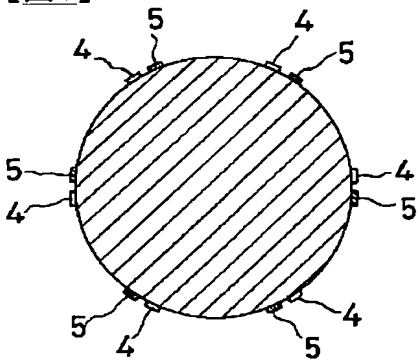
II
II
3
3
O
5
5
θb
III
III
4
4
6
7
6

【図2】


3
3
1
3
3
3
3

【図3】


5
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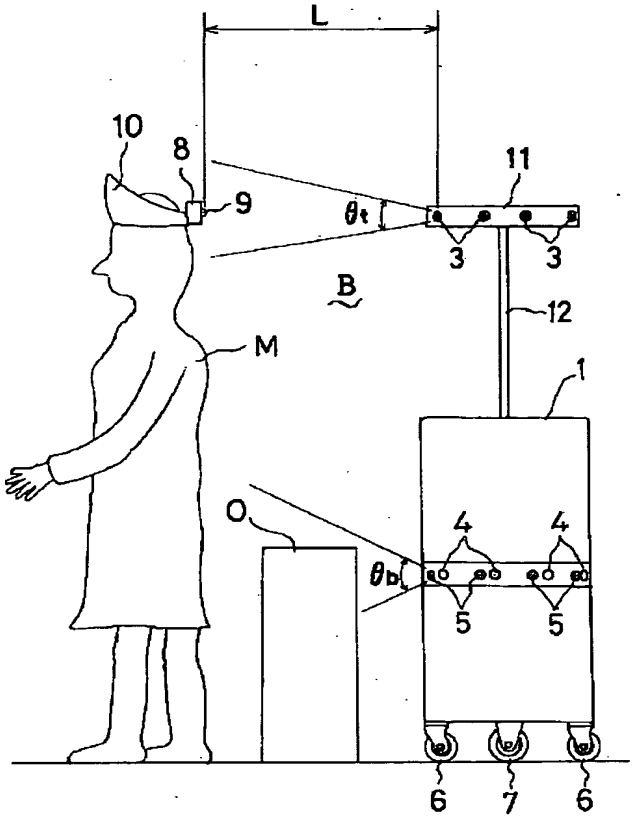
【図4】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